HBS Laboratory Facilities

Laboratory Space and Equipment of the Hydrospheric and Biospheric Sciences Laboratory and Associated Labs Relevant* to the HBS Contract Competition

A SUMMARY OVERVIEW
of Laboratory Space and
Related Lab and Field Equipment at Goddard
Plus Key Computing Facilities
(Greenbelt and Wallops Campuses)

Adapted from the
Code 614 Lab Space Committee's
Draft Report of Sep 2006

** NOTE: These facilities are being supported in part through the current Laboratory for Terrestrial Physics Support Services Contract and/or have the possibility to be supported in part under the Hydrospheric and Biospheric Sciences (HBS) Support Services Contract, which is currently (April 2008) being competed.*

HBS Laboratory Facilities Overview

The Hydrospheric and Biospheric Science Laboratory's (HBS; Code 614) research laboratory space on the main Goddard campus is contained in four buildings -- two on the east campus, Buildings 32 and 33, and two on the main or west campus, Buildings 22 and 28. Code 614 has some storage rooms available in Building 33 (D002) and in Building 22 (090 B & D). Additionally, other non-Code 614 laboratories are closely associated with work of the Hydrospheric and Biospheric Sciences and are located within Building 33, and will be supported under the HBS Support Services contract and, thus, are included herein. It should be noted that Code 614.4 lists herein some USDA/ARS off-site lab facilities and equipment. It is anticipated that these lab functions and the equipment will be transitioned in 2008 to the Greenbelt campus into some space in Building 33 (possibly to Rooms in F121).

Goddard/Wallops Hydrospheric and Biospheric Sciences Laboratory scientists primarily support the the Cryospheric Sciences Branch (614.1), Ocean Sciences Branch (614.2), and Instrumentation Sciences Branch (614.6), and Dr. John Gerlach (gerlach@osb1.wff.nasa.gov) is the primary POC for the Code 614 facilities. Wallops HBS activities have not generally been directly supported under the LTP Support Services contract, but some services are anticipated to be supported under the HBS Support Services contract (particularly those associated with Bill Krabill's airborne research programs). Hence, the Wallops HBS laboratory facilities are also included in this listing and descriptions.

GSFC Greenbelt Campus

Code 614.1, Cryospheric Sciences Branch

614.1 – Snow and Ice Research Facility (SIRF)

Bldg 33, Rm F010

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The goal of this facility is to provide limited space for study of snow and ice samples that have been developed for research or have been obtained during fieldwork. Samples cannot exceed ~1 cu. ft. at his time and sample space is already limited. A larger facility (Cryospheric Environment Research Facility or CERF, not yet developed at GSFC) is desirable for larger samples and for equipment that must be deployed adjacent to samples and/or tested at sub-freezing temperatures.

1) This facility was originally located in Building 28 space that was not suitable for the planned natural snow and ice sample studies, associated wet-lab activities, or associated cargo handling (Summer 2001 - Fall 2003).

2) The POC gained access to the current Snow and Ice Research Facility in Building 33 Room F010, in April 2003. This space, previously a machine shop, was remodeled as wet-laboratory space and the laboratory became functional in September 2003. This location has excellent access to the B33 loading dock area for cargo/sample handling.

3) The primary equipment of the current facility consists of a ~20 cu, ft. chest-style, research-grade, deep-freeze that is capable of ~-40 C and a ~16 cu. ft. upright, consumer-grade freezer capable of ~-20 C. A smaller ~10 cu. ft. rolling freezer modified to allow laser-testing of snow and ice samples is planned for the near future. A laboratory sink with counter space is available as well for water sample preparation and disposal. Note that the facility is not approved for chemical handling and no such use is anticipated.

4) Ancillary equipment for snow and ice deployments is also contained in SIRF. This includes: Hardigg cases, cold weather clothing, hand tools, scales, sample containers, snowshoes, and a crated microwave field instrument. Racks and cabinets hold these items and all of it is available for field deployment with coordination with the POC.

5) The facility has a single Apple workstation with an Internet connection on a desk. Space for equipment preparation and container packing/handling is also available.

Code 614.2, Ocean Sciences Branch

614.2 – Ocean Biogeochemistry Laboratory

Bldg 22, Rms C237 complex **Seawater Sample Processing Facility**
C237A **Biogeochemistry Analytical Laboratory**
C237B **Microscopic Visualization Facility**
C237C **Ocean Biology Experimental Laboratory**
C283Complex **Optical Properties Laboratory** (main, A, B)
C287 **Sterilization & Storage Facility**

Antonio Mannino, Official POC: 301-286-0182; antonio.mannino@nasa.gov

An ocean biogeochemistry laboratory was recently constructed at GSFC (2002-2003). The focus of the research is to study the distributions, sources and sinks of dissolved (DOM) and particulate organic matter (POM) in the ocean to enhance our understanding of carbon cycling, especially in the coastal zone. A primary objective is to link the optical properties of DOM and POM (such as absorption, scattering and fluorescence) to carbon in the ocean to be able to examine the carbon cycle using ocean color satellite measurements. Calibration/validation activities of ocean color satellite observations are also important aspects of the research conducted through the ocean biogeochemistry lab.

Seawater Sample Processing Facility in Rm C237
Millipore Elix10 & Milli-Q UV ultra-pure water system
CEM MARS-X microwave extraction system
Sorvall Legend RT centrifuge
Fisher sonic dismembrator with ultrasonic probe
ThermoSavant SpeedVac 1010 evaporation centrifugation system
Buchi Rotavapor evaporation system
N-EVAP Nitrogen gas evaporation unit
Furnace and drying ovens (2)
Flammable materials storage refrigerator/freezer
Fume Hood (chemical storage base cabinets)
Vacuum & peristaltic pumps
Filtration manifolds

Microscopic Visualization Facility in Rm C237B
Nikon Eclipse E600 Epifluorescence Microscope
Mettler-Toledo AX-26 analytical balance
Dever Instruments APX-602 balance

Biogeochemistry Analytical Laboratory in Rm C237A
Cary 100 UV-Vis spectrophotometer with PC data system
Shimadzu TOC-V analyzer with TN module, PC data system & Balston air purifier
Agilent 6890 gas chromatograph coupled to a 5973inert mass spectrometer and PC data stystem
Agilent High Performance Liquid Chromatography (HPLC) system with fluorescence and diode-array detectors and PC data system (degasser, quaternary pumps, thermostatted autosampler)
Fume hood (acid storage base cabinet)

Ocean Biology Experimental Laboratory in Rm C237C
VWR Plant environmental chamber

Optical Properties Laboratory in Rm C283A *(new activity – joint effort w/ Stan Hooker) I*n-water inherent optical properties package (calibration, maintenance & storage):

WET Labs ac-s & ac-9plus *absorption/attenuation meters*
WET Labs ECO-BB9 - 9-channel scattering sensor
SBE 49 FastCAT CTD
Biospherical PAR sensor
WET Labs chlorophyll fluorometer
Data handler & power control communication system
Aluminum cage
(NOTE: Italicized equipment is in the procurement phase)

Sterilization & Storage Facility in Rm C287
Steris AMSCO Century autoclave
Revco -85C upright freezer
Frigidaire chest freezer
Nuaire Bio-safety cabinet
Thermolyne 1400 furnace
Barnstead EASYPure water purification unit
Field equipment for ocean sampling (vacuum and peristaltic pumps and filtration manifolds)
Liquid nitrogen dry shippers

614.2 – Ocean Biology Processing Group Labs

Bldg 28, Rm W120D, W120E (note: formerly "SIMBIOS facility")
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Jeff Lentz, Operational POC: 301-286-8514; jlentz@seawifs.gsfc.nasa.gov

B28 Rm W120D – SIMBIOS optical laboratory

The SIMBIOS optical laboratory was installed in W120D in the summer of 2000 by the SIMBIOS program to monitor the radiometric stability of the SeaWiFS Transfer Radiometer II (SXR-II). It has also been used to characterize the FOV of the SXR-II. It contains two areas: one part of the room is the control area, from where the radiometers are controlled and the light sources are monitored. The other part of the room contains the light sources and the transfer radiometers (SXR-II and an irradiance radiometer). The SXR-II has been used in four radiometric calibration round robins from 2000 to 2003. The monitoring measurements are done on an approximately bimonthly basis in the expectation that the round robins will continue in the near future.

List of lab equipment:
- Optical table system (Newport)
- SXR-II (radiance radiometer), including one voltmeter and one temperature controller
- Irradiance radiometer, including one voltmeter and two temperature controllers
- SQM-II (SeaWiFS Quality Monitor) by Satlantic, Inc. (stable light source for low light levels)
- OCS 5002 by YES, Inc. (stable light source for low light levels)
- Spectralon panel, FEL lamps, lamp holder and precision current source (for reflectance measurements)
- 2 tripods

B28 W120E – SIMBIOS field equipment lab

The SIMBIOS field lab contains what leftover equipment from the old instrument pool that SIMBIOS used to maintain. Currently we have 2 PREDE's, 2 SIMBAD-A's and about 6-7 Microtops 2's along with some handheld GPS that we now rarely loan out to researchers. I think we have one SIMBAD out to Robert Frouin from California, and one Microtops to Ajit Subramaniam from Columbia University. Some of the rest of the older equipment was given to Brent Holben's group.

614.2 – Ocean Optics Laboratory

Bldg 28, Rms W120G, W129

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The lab space in W129 is used for instrument repair and staging field campaigns. Room W120G is used for instrument calibration and characterization. The optical field instruments, which are used to provide data from field campaigns, are an important aspect of the ocean color calibration/validation activities. The instruments available directly determine how much of the full problem set can be addressed (a lack of instrument diversity necessarily restricts the dynamic range of the problem):

a) Two SeaOPS instruments (both with the free-fall LoCNESS and THOR options) plus solar references;
b) One SeaFALLS free-fall profiler with reference;
c) SeaSAS, SUnSAS, and WLR-2800 above-water systems with references;
d) One miniNESS free-fall profiler with SeaSHADE reference;
e) One microNESS free-fall profiler with reference;
f) One microSAS instrument (with cardanic gimbal mount) plus gimbaled reference and changeable apertures for alternative fields of view;
g) One SeaPRISM above-water instrument; plus
h) The SQM and one SQM-II for monitoring the stability of the radiometers in the field.

In addition to the above-water and in-water optical measurements, a variety of ancillary data can be collected for a complete characterization of the marine environment during field campaigns:

i) Hydrographic observations (SBE 19 & SBE 911plus)
j) Attenuation and absorption (ac-9+) profiles; and
k) Fluorometer and transmissometer profiles.

Equally important are the calibration facilities and equipment required:

l) The SQM and one SQM-II for absolute radiometry experiments;
m) Two NIST (reflectance standard) plaques, one gray Spectralon™ plaque, and two white Spectralon plaques;
n) Four NIST FELs and two working lamps;
o) Radiance and irradiance monitoring sensors; and
p) The SXR.

Code 614.3, Hydrological Sciences Branch

614.3 – Hydrology Wet Lab

Bldg. 22, Rm G007

Manfred Owe / Peggy O'Neill Official POCs:

Description

- Sink (x2) – deep laboratory style, chemical resistant, H/C water, w/ spray nozzle hose, eyewash, glassware drying rack
- Fume hood, with sink, chemical storage lockers below
- Counters along 2 walls
- Wall cabinets above and below counters
- Island countertops (x2), w/ electric, cabinets below
- Electric raceway along walls
- Drying oven

Uses

- Process and analyze field samples – water, soil, vegetation
- Physical and chemical analyses
- Equipment calibration and maintenance

Code 614.4, Biospheric Sciences Branch

614.4 – Biospheric Sciences Optics Laboratory

Bldg 33, Rm F121A

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The main purpose of this lab is the general field instrumentation lab support and field trials for code 614.4 Biospheric Sciences Branch.

Lab operations:

1) Maintain and calibrate field and lab instruments.
2) Provide lab and field support for system, test and evaluation.
3) Design and fabricate sensor electronics and computer subsystem and components for sensor data acquisition, computer interface, and digital control.
4) Design and implement system modifications as required.
5) Install and evaluate performance of modified hardware and software systems.

Instruments:

1) Spectroradiometers - Model FieldSpec PRO (5 units) made by ASD
2) Infrared Thermometers – Various models made by Everest.
3) Blackbody – Model EABB250 made by Advanced Kinetics.
4) Spectral calibrations lamps – Hg lamp, Ag lamp, Krp lamp, and Xe lamp by CVI.
5) Spectral lamp power supply – Model AS 260 by CVI.
6) Monochromator – Model DK 240 by CVI.
7) 30” integrating sphere – by Spectron.
8) Spectralon panels – 5” (3 units), 10” (2 units), 20” (3 units) by Labsphere.
9) LXR – Landsat7 Transfer Radiometer by NIST.
10) ILX Modular Laser Diode Controller.
11) Panasonic Tough Book model 37 (2 units) laptop computers.
12) 3’ x 8’ Optical table by Ealing Electro-Optics.
13) Oriel 300w radiolmetric power supply (2 units).
14) Oriel Merlin System for radiometric measurements and calibrations.
15) Kepco power supplies – various models.
16) Fluke multimeter model 8842A (2 units).
17) LAI-2000 – Plant canopy analyzers (2 units).
18) GeoExplorer II GPS system.

Non-active instruments are stored in building 22, room G090B. Code 614.4 branch secretary Sandi Bussard maintains an inventory list.

House Keeping:

1) Schedule the use of field use instruments and maintain instrument traffic log.
2) Maintain instrument calibration log.
3) Update MSDS PRO for chemical inventories to Center database.
4) Purge ETM+ panel biweekly.
5) Maintain government safety regulations including any move-related actions.

Other obligations:

1) Support Portable Airborne LASER System for Forest Inventory project (Ross Nelson, code 614.4).
2) Support Laser-Induced Florescence project (Betsy Middleton, code 614.4).
3) Support Calibration Facility (Jim Butler, code 614.4).

614.4 – Biospheric Sciences Wet and Dry Labs

Bldg 33, Rms F121D, F121E (F121C used as operator office)

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The lab space in F121 is used for Laboratory analysis of soil, rock, and plant specimens to support research and education projects at GSFC.

F121D – Biospheric Sciences Wet Lab

Room F121D is a "wet lab" used for preparing and analyzing samples that may need chemical treatment or that use water in the analysis. There is a chemical hood set up for use of volatile chemicals, a drying oven for determining mass of samples, a distilled/deionized water unit, a sink, a refrigerator, microwave oven, an autoclave, and various other instruments and materials for laboratory analyses (e.g. glassware, pH meter, balance, other items for soil characterization). The table in the center of the room is setup to allow gases to be used for lab analysis, but this is not in use at the moment. A section of the lab is set up with a computer and printer for visiting scientists and students to use as a work space.

F121E – Biospheric Sciences Dry Lab

Room F121E is a "dry lab" for preparing and working with samples that require "dry" conditions without liquid input of any kind. It contains a muffle furnace for analysis of carbon, and a vented area for working with samples that would otherwise create dust in the room. This room also ahs a sink where soil and plant materials can be washed and an area for storage of samples and equipment. A small part of the room is set up with a computer for students or visiting scientist work.

The laboratory is currently in use for the following projects:

1. Determination of dielectric properties of frozen lunar soils
2. Analysis of properties of soils from a Bolivian meteorite crater
3. Preparation of materials for tactile educational materials for blind students
4. Preparation of soil and other materials for trainings of GLOBE teachers and students

In previous years, it has also been used by numerous visiting scientists, and high school and college interns. The space is available for use by others throughout GSFC by request.

614.4 – Calibration Facility

Bldg 33, Rm B323 EOS-Radiometric Calibration and Dev. Facility
D319 EOS Calibration - Sphere Lab
D327 EOS Calibration - Engineering Lab
D327A EOS Calibration - Back Lab
F311 EOS Diffuser Calibration Facility

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The GSFC Code 614.4 Calibration Facility (CF) maintains instruments and NIST-traceable calibrated sources to calibrate, monitor, and assess the performance of satellite-, aircraft-, and ground-based remote sensing instrumentation. CF instruments and sources span the spectrum from UV through Visible and into IR.

CF instruments, sources, and expertise are available to US Government agencies, the international remote sensing community, and academic institutions.

Engineering Lab

B323 - A dedicated area for development, testing, and storage of the equipment required to maintain the sources and generate accurate source calibrations.

Sphere Lab

D319 - A dedicated area in which Hardy, the 6' sphere, is located. A moveable 4' x 4' **optical table is also located in this space.**

CF Main Lab

D327 - A flexible area used during calibration of guest instrumentation. This space includes a moveable, exposed 4' x 8' optical table and a stationary, enclosed 4' x 8' optical table. Laurel, the 4' hemisphere, and Spike, the 4' sphere, are normally located in this space.

CF Back Lab

D327A - A flexible area used during calibration of guest instrumentation. This space includes a 4' x 10' optical table. Slick, the 4' Teflon sphere, is normally located in this space.

DCF Lab

F311 - A dedicated area housing the Diffuser Calibration Facility (DCF) scatterometer. This space is contamination controlled to Class 10,000. es, the international remote sensing community, and academic institutions

614.4 – AERONET Laboratory

Bldg 33, Rm F541 & Aeronet "Penthouse" storage trailer and "lab"

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Wayne Newcomb, Operator POC: 301-614-6634; wnewcomb@ltpmail

The lab space in 33/F547 is used for three engineer and technician offices, instrument repair, maintenance, adjustment and staging field campaigns. The AERONET storage trailer is used for clean room like instrument calibration and characterization and termperature controlled lidar (MPLNET) operation. The optical field instruments, which are used to provide data from field campaigns and global monitoring, are an important aspect of the AERONET calibration/validation activities.

The instruments on site and maintained directly determine how much of the AERONET global network is available for validation and synergism with airborne and satellite retrievals and field campaigns:

q) Typically 25 to 40 instruments are in the calibration process;
r) Approximately 6 weeks are required to complete the calibration process;
s) New instruments are under development to improve existing capabilities; multispectral polarization radiometer and SeaPRISM
t) New instruments are under development that will provide new capabilities to the AERONET program; CO_2 radiometer
u) Handheld sun photometers used for field campaigns;
v) Approximately 30 400 mhz Data Collection Platform transmitters for AERONET data collection;

In addition to the field instruments, the maintenance equipment includes:

w) Various tools and implements to facilitate the AERONET program;
x) Hazardous waste storage container;

Equally important are the calibration facilities and equipment required:

y) 1 solar simulator;
z) 1 Labsphere integrating sphere;

Code 614.4 – USDA/ARS (off-site) Lab Facilities and Equipment

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Code 614.4 operates laboratory facilities and maintains laboratory and field equipment that is currently located at USDA/ARS in the Hydrology and Remote Sensing Laboratory, Beltsville MD. The facilities consist of office space (~200 sq ft) and 2 adjoining rooms for laboratory activities. These labs are: a wet chemistry and spectroscopy area (~255 sq ft) and a dark room for optical/imaging systems and instrument calibration and assembly (~170 sq ft). The laboratories contain the optical breadboards, alignment tools, and most of the diagnostic equipment required for operation of the following systems:

An optical properties workstation consists of an spectroradiometer (ASD-FR FieldSpec Pro, Analytical Spectral Devices) fiber-coupled to a Li-COR 1800 integrating sphere for measurement of reflectance and transmittance of materials from 350 to 2500 nm.

Perkin-Elmer Lambda 40 Spectrophotometer is located in the wet chemistry laboratory and used for the determination of absorptive properties of liquid and solid samples over the wavelength range of 190 to 900 nm.

The Spex Fluorolog II & III spectrofluorometers used for high resolution determination of fluorescence excitation and / or emission spectral properties of solid or liquid samples over the spectral range of 300 to 900 nm.

The Laser Induced Fluorescence Imaging System (LIFIS) which consists of 125 mJ Nd:Yag laser and fast-gated intensified CCD cameras and peripherals such as lenses, optics, and PC. Interface. The system is used for UV (355 nm) or VIS (532 nm) induced fluorescence imaging of large objects.

The fluorescence imaging system (FIS) consists of four longwave UV lamps, a 16–bit intensified CCD imaging camera coupled to an automated filter wheel with up to five band pass interference filters. The system is used in a dark room to analyze the spatial variation of fluorescence over objects up to 6 square inches.

The simulated solar induced fluorescence system used an Oriel 300w solar simulator with interference filters as an illumination source with two ASD spectroradiometers to quantify solar induced fluorescence emission from solid samples.

Code 614.5, Terrestrial Information Systems Branch

This branch has no traditional research "laboratories" *per se*, but branch members occasionally utilize field and other equipment that is "staged" in Bldg. 33, Room F121-A. It is helpful to have one point person responsible for reserving and maintaining equipment and a consistent and safe place to store equipment when it is not in use. Grants supporting research work by branch members have bought certain equipment (e.g. LAI-2000s) which is used roughly 5% of the year (through episodic field campaigns), and such equipment has to be housed and maintained. Other equipment "owned" by other projects is also utilized by branch members during such episodic campaigns.

Code 614.5 considers pooling their equipment with others and having them managed by someone (e.g., Milton Hom, electronics technician in F121) other than individual scientists, who have infrequent needs for the equipment, is highly desirable. Maximizing the coordination of this equipment is perceived to yield cost savings and better use of the equipment, and there may be an opportunity to expand this coordination to the lab or division level. For example, it was suggested that a more coordinated equipment "lending" center (like a library) might be worth considering. (relevant POC for this activity of Code 614.5 is Jeff Morisette)

614.5 Laboratory Computing Facility

Bldg 33, Rooms H111 and F105
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The Laboratory computing facility consists of 1,088 sq. ft. in Building 33 Rooms H111. This space is primarily used to house servers for projects, Landsat and the Crustal Dynamics Data and Information System (CDDIS), and servers that perform key infrastructure functions for the Laboratory including:

- 3 servers hosting web sites
- 1 mail server
- 2 servers responsible for backing up desktop systems in Buildings 32 and 33 and critical source codes and executables in the MODIS computing facility in Building 33
- 1 server that handles software licenses and applications software
- 1 server that manages user accounts

The space in H111 also includes work tables and computer systems used by staff supporting desktop systems in the HBS Laboratory and Earth Sciences Division when they are repairing a system or configuring a new system.

The Laboratory computing facility also includes Building 33 F105, a 310 sq. ft. room, with 7 Dell desktop systems used for analyzing remote sensing data using image processing packages, ENVI, IDL and PCI Geomatics, and GIS applications from ESRI. The following peripherals are also available in F105 and supported by the desktop support team:

- 11x17 flat bed Epson color scanner attached to Apple computer
- 1 HP designjet 5500 color ink jet plotter
- 1 HP laserjet 9500hdn color printer
- 1 HP laserjet 8000 b/w printer

Code 614.5 MODIS and OMI Processing Facility

Bldg 33, Room S-009
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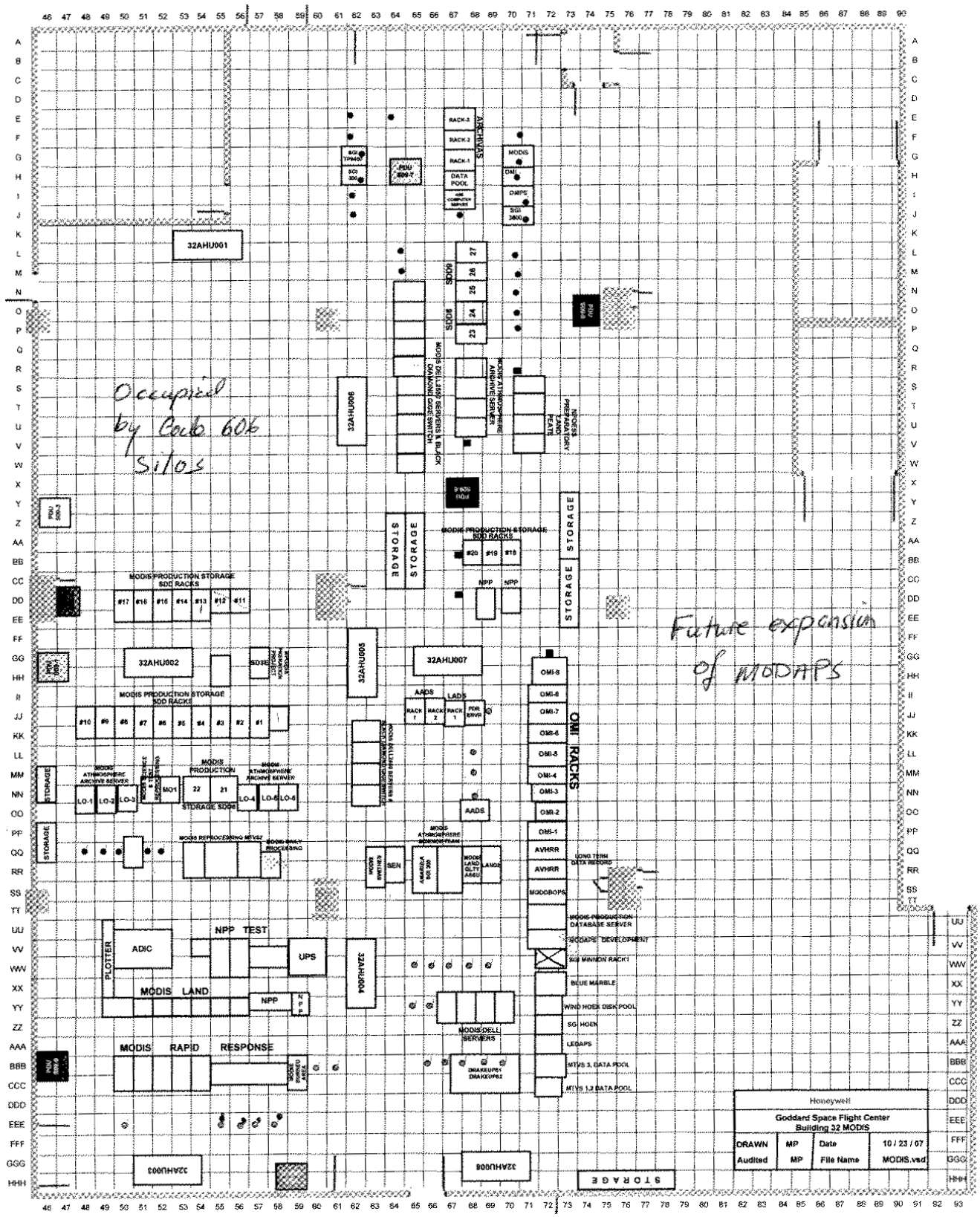
The MODIS and OMI computing facility in Building 33 Rooms S-009 covers 4,500 sq. ft. of raised computer room floor. In 2009, an additional 800 sq. ft. of raised floor will become available for MODIS and OMI processing systems. Temperature and humidity are controlled by 7 in room air handlers for our portion of S-009 shown in the figure below (next page). Conditioned power to the MODIS and OMI systems is supplied by the Building UPSes (Uninterruptible Power Supplies) through 7 PDUs (Power Distribution Units) ranging from 75KVA to 125KVA each.

Current computing equipment in the facility occupies 112 computer racks. There is sufficient space and power to support an additional 110 racks over the course of the contract. At present, more expansion of our data systems is planned amounting to 5to 7 racks of compute servers (20 servers per rack) and 3 to 6 racks of disk storage (~200TB per rack) per year.

The current systems installed in the facility include:

- 6 Silicon Graphics Origin servers (Origin 3800, 3200 and 300)
- 10 Data Direct Networks storage systems (SA26000, 8000 and 9550) (747TB)
- 404 compute servers
- 20 database servers
- 51 files servers with 212 host attached RAID units total 600TB of storage
- 3 Enterprise-class network switches support connections at 1Gbps to 10Gbps
- 30 Smaller Ethernet switches



The MODIS and OMI computing facility

Code 614.6, Instrumentation Sciences Branch

614.6 – Microwave Sensor Laboratories

Bldg 22, Rms C179 complex, C179 A
Bldg 33, Rms B409, B409A, B409B (and B-Roof)

Ed Kim – Official POC: Ph.: 301-614-5653); E-mail: ed.kim@nasa.gov

The Greenbelt portion of Code 614.6 (i.e., the former Microwave Sensors Branch, code 975) operates laboratory facilities in 2 buildings: B33 and B22. 614.6 also works very closely with Code 555, the Microwave Instrument Technology Branch and Code 567, the Microwave and Communication Systems Branch, using many of their lab facilities in B19. The 3 branches also co-share equipment all the time. The facilities, equipment, and capabilities are relatively seemlessly integrated across these 3 branches. Of particular note is the anechoic chamber in B19, used to make antenna measurements & whole-instrument calibrations. This description will focus on the 614.6 facilities. The descriptions of unique instruments include several microwave instruments from code 613.1 which were developed & are currently housed in these labs. [The Wallops portion of Code 614.6 will be described / inventoried separately.]

The main use of the Microwave Sensor Laboratories is for the construction, testing, calibration, and deployment of airborne passive and active microwave remote sensing instruments—radiometers and radars. As microwaves have long wavelengths (e.g., ~30cm), obtaining useful spatial resolutions requires large antennas (1.2m is common), and instruments with large antennas take up larege spaces. A square-foot tax may negatively impact these labs & capabilities disproportionately.

Both the B33 & B22 labs are kept as large open areas that can be divided as needed, depending on the space needs of the various instruments. The labs are equipped with basic tools & equipment for electronic, microwave, and mechanical work. The primary "water cycle" frequency range of interest is 1-100 GHz, but measurement capabilities & applications exist from 0 to near 1000 GHz. A detailed list of lab test equipment would be quite long, but general properties that can be measured include power, gain, frequency, phase, spectra, time waveforms, aborption, transmission, & reflection coefficients, circuit elements, noise properties, antenna patterns, etc. We have signal sources, arbitrary waveform generators, noise sources, vector network analyzers, oscilloscopes, and specialized microwave radiometer calibration equipment.

The same microwave equipment used to measure & calibrate microwave electronic circuits & microwave remote sensing instruments is also what one uses to make microwave measurements of material samples. So, we also have capabilities for measuring microwave properties (dielectric constant, reflectance, absorption, etc.) of natural materials (soil, vegetation, ice, water, chemicals, inorganic & organic materials, etc.) in the lab, and to a lesser extent, in the field.
Considerable experience & technical information exist within the branch regarding a wide variety of airborne platforms & aircraft organizations.

Both the B33 & B22 labs have limted machine shops, with drill presses, sanders, a milling machine, bandsaw, brake, compressed air, plus hand tools for metalworking, woodworking, etc. The B22 lab has 400Hz 3phase power to simulate that type of aircraft electrical power and a printed circuit board mill. The B33 lab has a fume hood. Calibration often utilitzes liquid nitrogen, so we have very basic gear for handling LN2 plus precision cryogenic temperature sensors. On the roof of B33 is a work platform (approx 10 x10 m). Adjacent to the platform is a shipping container converted into lab space, the "Transportable Microwave Lab" as it is detachable & shippable worldwide. The roof facility is used by instruments needing to view the sky, the ground, or the trees. We also have an 18m telescoping antenna tower on a towable trailer, used to deploy ground-based instruments. The trailer includes a 7.5kW diesel generator.

A list of deployable unique instruments follows below. The scientific applications span the whole range of water and energy cycle components, weather, climate, & biospheric/carbon cycle uses. As such, the instruments are used during any/all seasons.

Cal/val of spaceborne microwave sensors is the primary use. Deployments are most frequent during algorithm development & immediate-post-launch phases. Deployments particularly make use of large amounts of floor space for crating & un-crating the large instruments. One instrument deploying typically fills one of the large lab rooms. Two instruments deploying at the same time makes for cramped quarters. Lab activity is very unpredictable year to year & month to month as it depends largely on field experiment funding from HQ. Note that any of the aircraft instruments can also be deployed on the ground, and as part of simple/small experiments, not just large field campaigns.

LIST OF CURRENT Code 614.6 Greenbelt instruments (+ Heymsfield/613.1)

Passive microwave (radiometers)

ESTAR

The original Electronically Scanned Thinned Array Radiometer. Uses aperture synthesis in one dimension, real aperture in the other, L-band. Possibly flyable but superceded by newer 2D-STAR instrument. Applications: soil moisture, ocean salinity. Contact: David LeVine.

2D-STAR

A 2D thinned array L-band radiometer that uses aperture synthesis in two dimensions. Applications: soil moisture, ocean salinity. Contact: David LeVine.

CoSMIR/ CoSSIR

The Conically Scanning Millimeter/Submillimeter-wave Imaging Radiometer is a conical scanning, airborne microwave radiometer covering the frequency range of 50-640 GHz. Interchangeable heads: 50-183 and 183-640 GHz. Currently can fly only one head at a time. Applications: atmospheric water vapor, ice, clouds, hurricanes. Contact: Jim Wang.

AESMIR

The Airborne Earth Sciences Microwave Imaging Radiometer is a conical scanning, airborne microwave radiometer covering the frequency range of 6-90 GHz. Applications:

soil moisture, vegetation, snow/cold lands, sea ice, sea surface temperature, atmospheric water vapor, precip. Senses all 4 Stokes parameters. Contact: Ed Kim.

MIR
The Millimeter-wave Imaging Radiometer is a cross-track-scanning radiometer that measures radiation at 7 frequencies of 89, 150, 183.3 +/- 1, 183.3 +/- 3, 183.3 +/- 7, 220, and 340 GHz. Applications: atmospheric water vapor, ice, clouds, hurricanes. Still flyable, but essentially replaced by COSMIR. Contact: Jim Wang.

ACMR-P
The Airborne C-band Microwave Radiometer-polarimetric is a fixed-beam 6.8 GHz ground-based/airborne radiometer. GSFC's first 4-Stokes microwave radiometer. Applications: soil moisture, vegetation. Contact: Ed Kim.

Active microwave (radars)
RadSTAR
RadSTAR is an L-band (1.2 GHz) radar with multiple beams forming a cross-track imager. It has some Synthetic Aperture Radar capabilities, and can be paired with an L-band passive imager to conduct combined active/passive retrieval studies. Applications: soil moisture, ocean salinity. Contact: Peter Hildebrand, Rafael Rincon.

EDOP
The ER-2 Doppler radar is a weather radar system at X-band (9.6 GHz) (EDOP) flown on the ER-2 aircraft. EDOP is fully coherent with fixed nadir and forward pointing off-nadir beams that map out Doppler winds and reflectivities. Applications: precip, winds. Contact: Gerry Heymsfield/613.1.

Cloud Radar System
The CRS is a 94 GHz (W-band; 3 mm wavelength) Doppler radar developed for autonomous operation in high-altitude aircraft and for ground-based operation. Provides profiles of reflectivity and Doppler velocity in clouds. Designed to fly with the Cloud Lidar System (CLS). Applications: clouds. Contact: Gerry Heymsfield/613.1.

Code 694, Laser Remote Sensing Laboratory

LIDAR Optical Systems Lab

Bldg 33, Rm F303

POC: Vibart Stan Scott; Ph.: 301-614- 6280; E-mail: Stan.Scott@nasa.gov@nasa.gov

The LIDAR Optical Systems Lab is an 1100 sq. ft. total laboratory owned by Code 694, which is the Laser Remote Sensing Laboratory. The lab is set up to perform optical integration and testing of small LIDAR instruments for aircraft, flight and research and development breadboards. The lab is equipped with the following instrumentation and capabilities:

- 370 sq foot Class 10,000 clean room facility
- 680 sq foot Class 100,000 clean room facility
- 100 cm diameter, 5 meter focal length collimator
- Davidson 40 cm diameter, 2.7 meter focal length collimator
- Space Optics Research 32 cm diameter, 2.5 meter focal length OAP collimator
- Zygo GPI XP interferometer
- Perkin Elmer UV/VIS/NIR Spectrometer Lambda 900
- Tenney T30C environmental chamber
- Diversified Vacuum Inc vacuum chamber
- Nikon mm-40 measuring microscope
- Flight bonding station
- Scientemp Ultra low temperature cabinet
- Class 100,000 clean room pre-cleaning station

Also,

- Numerous theodolites, autocollimators, optical flats, alignment lasers and light sources, calibrated power meters, wave meters, and a full assortment of optical mounts, lens kits and optics.

- The facility also includes many ESD (Electro Static Discharge) controlled workbenches and ESD control equipment as well as data acquisition and image capture computers, motion controllers, multiple oscilloscopes, power supplies, pulse generators, signal generators, counters, and analyzers.

Mechanical Lab

Bldg 33, Rm F403

The Mechanical Lab (Building 33 room F403) is a 600 sq. ft. facility for designing and manufacturing quick turn-around prototypes. The lab is equipped with high speed Haas CNC machine tools, for fabrication test and assembly work. (no figure provided for this).

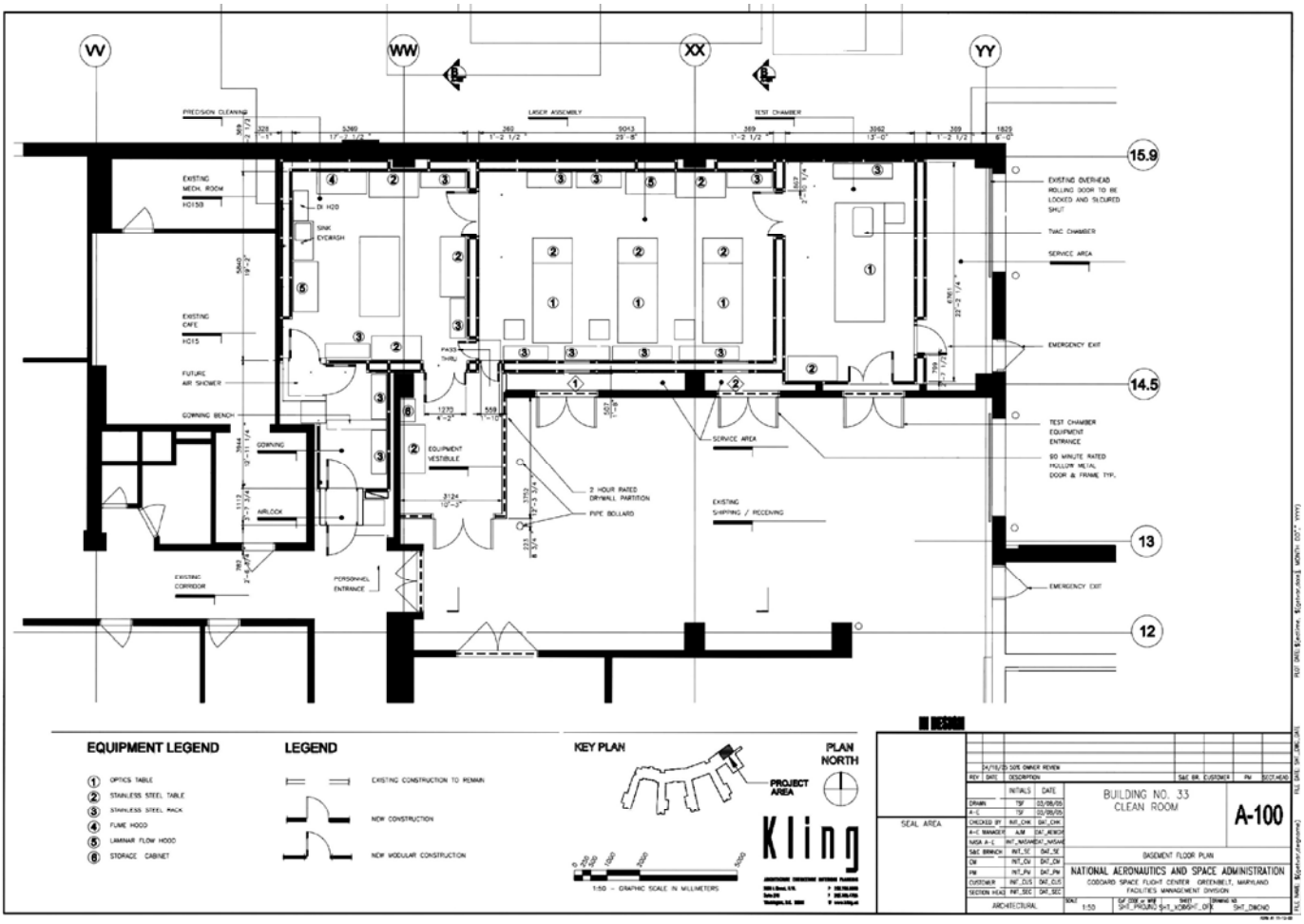
Code 554, Laser & Electronic Optics Branch

Space Laser Assembly - clean room

Bldg 33, Rm H017

POC: Pamela S. Millar; Ph.: 301-614-6730; E-mail: Pamela.S.Millar@nasa.gov

The Space Laser Assembly clean room, SLAC, operated by Code 554, is a 1500 sq. ft. class 1000 clean room (Building 33, Rm F303) designed and built to support the fabrication and testing of diode pumped solid state (DPSS) laser transmitters for flight similar to what GSFC developed for the Geoscience Laser Altimeter System. The fabrication of the facility was completed in FY07, however a problem with the noise levels is being mitigated by a minor redesign of the facility, which is expected to take place during FY08 and completed during early FY09. The layout (see the figure below) shows 3 separate areas, from left to right the first area is for precision cleaning and parts inspection, the central area with 3 optical table setups is meant to support 3 separate laser assemblies with areas against the back wall for bonding stations, and the 3rd area on the right is the thermal vacuum test setup.



GSFC Wallops Flight Facility

Wallops scientists primarily support the The Cryospheric Sciences Branch (614.1), Ocean Sciences Branch (614.2), and Instrumentation Sciences Branch (614.6). Dr. John Gerlach (gerlach@osb1.wff.nasa.gov) is the primary POC for the Code 614 facilities identified in this section.

GPS Prep/Storage Lab
WFF Room E106, Bldg. N-159
POC: Earl Fredrick, EG&G

This facility is used as a storage, testing, preparation and repair area for Global Positioning Equipment primarily used in supporting Airborne Lidar projects flown on the NASA P-3 aircraft and leased aircraft platforms. Along with GPS receivers, support equipment, cables and small shipping containers are stored in this lab.

Optical Instrument Calibration Lab
WFF Room E104, Bldg N-159
POC: Jim Yungle, EG&G

This small lab contains an wooden framed light tight enclosure that is used as an optical calibration facility. The enclosure is light-proof against the fluorescent light afterglow using many black cloth baffles to ensure no outside light leakage. It contains optical benches that hold NIST calibration lamps and reflectance plaques to allow calibration of remote sensing equipment.

Laser Remote Sensing Lab
WFF Room E107, Bldg N-159
POC: Jim Yungle, EG&G

This recently refurbished lab contains a large Newport optical table which can be elevated on isolation stands. There are also several workbenches and a laboratory sink. This lab is presently used for testing laser-induced phytoplankton fluorescence detection equipment (both shipborne and airborne varieties).

Airborne Instrument Storage Room
WFF Room E108, Bldg N-159
POC: Jim Yungle, EG&G

This large room is used to store airborne remote sensing equipment between airborne missions. There are many storage cabinets, large shipping boxes, and aircraft racks stored in this room.

Remote Sensing Instrument Laboratory
WFF Room E109, Bldg N-159

POC: Jim Yungle, EG&G

This large lab is presently used to set up and operationally test airborne remote sensing equipment that has been brought out of storage in E108 (interconnecting door). The windows on the north side allow GPS antenna cables to pass from the outside antenna to the aircraft equipment racks. Recently the NASA Shipboard Laser Fluorometer (SLF), NASA Oil Detection Lidar, and NASA Airborne Topographic Lidar (ATM4b) have been brought to operational status in the lab.

Radar Systems Laboratory
WFF Room E113, Bldg N-159
POC: Lester Atkinson, CSC

This Lab provides office and work space for the TRMM radar support team. It includes workbench and tools for working on components of the NASA TOGA C-band radar and the NASA S-band Polarimetric radar (NPOL), computer workstations for analyzing radar data and data archiving facilities.

Microwave Instrument Laboratory
WFF Room E114, Bldg N-159
POC: John Gerlach (acting), NASA

This medium lab is a working area microwave airborne instrument such as the Scanning Radar Altimeter (SRA) and the Radar Ocean Waves Spectrometer (ROWS). Other projects use this area to work on wiring projects due to the well-instrumented electronics bench. Small offices E114a and E114b open into this area.

Ground Test Lab
WFF Room E115, Bldg N-159
POC: Jim Yungle, EG&G

This small lab is used to conduct "ground testing" and calibration of remote sensing instruments. This lab has outside access to the N159 aircraft ramp and the branch has an approved Operational Safety Directive (OSD) to allow testing of laser remote sensing instruments with proper safety procedures and notification of the WFF airport control tower.

Microwave Instrumentation Storage Area
WFF Room E116, Bldg N-159
POC: John Gerlach (acting)

This medium lab is a storage area for the SRA.

Upper Air Instrumentation Lab
WFF Rooms E118, E120, E121
POC: Frank Schmidlin, NASA

These labs support the Wallops atmospheric measurement program. Room E118 is storage for balloons and radiosondes. Room E-120 is used to prepare and calibrate ozonesondes and includes a primary ozone standard. E121 is used to support field deployments.

Biogeochemical Lab
WFF Rooms E-101, E-102, E-103

Tiffany Moisan, Official POC:

Room E-101 is a fully equipment biochemical lab with a large temperature controlled chamber, fume hood, microscopes and an array of instrumentation described in the attachment. E-102 is office space for the contract lab technicians. Room E-103 is the testing, build up and preparation room for instrumentation used to support in situ measurements and field campaigns.

Dr. Moisan has numerous facilities and equipment available at NASA Wallops Flight Facility. Some of Dr. Moisan's work involves primary productivity experiments, for which she has two photosynthetron units to create P vs. I curves. For spectral analysis work, she has a Perkin Elmer Lambda 800 UV/VIS spectrophotometer and Perkin Elmer LS50B spectrofluorometer. Additional laboratory equipment includes a Turner Model 10-AU Fluorometer, a drying oven, liquid nitrogen dewars, several filtration racks, a Steris autoclave, an environmental chamber, various culture glassware, a pH meter, a microbalance, reverse osmosis water, an Olympus BX-51 Microscope with DAPI, FITC, and FL filter cubes, and several circulating water baths. Dr. Moisan's culturing facilities consist of a 12 x 8 foot environmental chamber and sterile transfer hood for the growth and maintenance of numerous stock cultures at NASA WFF. She currently maintains eleven species of phytoplankton and cyanobacteria, representing a variety of groups and properties for laboratory experimentation and instrument calibration.

Numerous state of the art field instruments have recently been purchased for use by Dr. Moisan. She has two Satlantic ISUS Nitrate Sensors, two Wet Labs AC-9s, a Wet Labs AC-spectra, a Wet Labs ECO Triplet fluorometer with chlorophyll, phycoerythrin, and CDOM sensors, a Wet Labs ECO VSF, a Hobi Labs Hydroscat-2, a Hobi Labs a-Beta, and four Sea Bird Electronics MicroCAT CTs. Dr. Moisan has also recently purchased a Sea-Bird Electronics CTD for use on a profiling rack, which is capable of holding all of the above-mentioned field instruments to create vertical profiles of the water column. With these optical instruments, we are capable of measuring absorption (83 wavelengths), backscatter, fluorescence (chlorophyll, phycoerythrin, CDOM), volume scattering function, nitrate concentrations, conductivity, and temperature. Dr. Moisan also has a Biospherical Instruments PRR-800 profiling radiometer and a PRR-810 surface reference radiometer for measurements of upwelling and down-welling irradiance in the water column.

In addition to her profiling field instruments, she has recently purchased a Wet Labs Diving Optical Profiler and High-speed Integration Network (DOLPHIN), which is an undulating towed vehicle that consists of a Sea Bird Electronics CTD, a Wet Labs AC-spectra, and a Wet Labs ECO Triplet fluorometer with chlorophyll, phycoerythrin, and

CDOM sensors. The DOLPHIN allows continuous transects of inherent optical properties (IOPs) to be obtained at user-defined depths.

At present, we have access to a 4 processor Sun Ultra-80 and a 2 processor SGI-Octane that are both located in our local computer room. These computers are linked to an older 80 Gigabyte disk bank that is presently being used to archive the satellite data sets and historical ocean data (COADS/NODC-XBT) and model results. Two HP (b/w and color) regular page printers and a wide (36") format HP Jetdirect color printer are available for use under work related to this proposed effort. In addition to this, we have experience in running coupled physical/biological models and data assimilation models on the NASA/GSFC Compaq cluster supercomputer. A request for time on this machine is located in Section F. The workstations and printers are located in the NASA/GSFC Observational Science Branch computer room (Wallops Flight Facility, Bldg N-159, Room E-219).

Dr. Tiffany Moisan has laboratory space with cabinetry and fume hoods for the processing of biogeochemical samples. She also shares resources with the chemistry laboratory and water quality facility. Office space at NASA/GSFC for the PI (Wallops Flight Facility, Bldg N159, Room E213) and the laboratory technician is being provided by NASA/GSFC.

AeroScience Laboratory Facilities

The AeroScience Lab has been created to research and develop new instrument and platform systems suitable for small uninhabited aerial vehicles (UAVs). These miniaturized "Sensors with Wings" provide quick-response, low cost measurements as compliments or options to observations from satellites or manned aircraft. Our laboratory spaces are capable of providing integration and testing areas for in-house development, as well as collaboration with an array of partners from within NASA, other government agencies, academia, and the commercial sector. Space is also available for visiting scientists, technical teams, and students supporting related projects at Wallops

WFF Room W-132, Bldg N-159

POC: Geoff Bland, NASA

This work area is conveniently located near the Air-Sea and Rain-Sea Interaction Facilities, both of which are often operated for collaborative research. This space also has access to the hanger and airborne instrumentation labs as well, making it ideal for visiting scientists and research teams. It is regularly used by visiting personnel, and long-term access for one or two persons can be arranged.

WFF Bldg X-15, Wallops Island

POC: Geoff Bland, NASA

Building X-15 is located on Wallops Island, with access to a dedicated UAV runway within the NASA controlled Restricted Airspace R6604, the Atlantic Ocean, and outside space suitable for a variety of systems testing. It is the primary lab facility for the Applied

Engineering and Technology Directorate (AETD) supported testing and development of our experimental UAV systems, and houses instrument and vehicle systems fabrication, integration, and preparation areas. Office and lab space for research and analysis activities are also included. There is a large environmentally controlled “High Bay” area, combined with smaller lab and office spaces. It is well suited for commercial UAV operators and is used for a variety of NASA UAV-related activities. BAI Aerosystems has operated UAVs for instrument research from this facility, and Aerosonde NA and NASA Langley Research Center are frequent guests when working on projects managed by the Wallops Range and Mission Management Branch. Additionally, the Wallops Meteorological Operations Group maintains a tethered aerostat system in this location, which is regularly used for atmospheric research and sensor development.

WFF Rooms W-138 and W-140, Bldg N-159

W-140 is a rain tower housed in what was a parachute drying area of the hanger. An array of nozzles at the top of the tower can produce rain drops of varying sizes which impinge on the surface of a water tank. The characteristics of the falling rain drops as well as the interactions with the water surface are studied to understand how remote sensing satellite sensors are affected by rain cells over the ocean.

NASA Air-Sea Interaction Facility (NASIRF)

WFF Rooms W-133 and W143 Bldg N-159

Steve Long, Official POC:

The NASIRF facility is the home of a 60 ft. wave tank where waves can be created either by a paddle in the water or by wind passing over the surface of the water. The temperature of the water and the air can be controlled allowing not only the study of the physical interaction between the water and the air but also the exchanges of gases between the two medium. The primary objectives of the facility is to test theoretical results and to collect empirical data for the development of remote sensing techniques, in support of microwave remote sensor development and algorithms for air-sea interaction studies within the framework of the Sciences and Exploration Directorate of the NASA Goddard Space Flight Center.

The primary objectives of the facility is to test theoretical results and to collect empirical data for the development of remote sensing techniques, in support of microwave remote sensor development and algorithms for air-sea interaction studies within the framework of the Sciences and Exploration Directorate of the NASA Goddard Space Flight Center.

The main wind-wave-current interaction test section is 60 feet (18.29 meters) long, 4 feet (1.22 meters) high, and 3 feet (.91 meters) wide, filled to a water depth of 2.5 feet (.76 meters), with 1.5 feet (.45 meters) remaining for air flow. The facility is capable of winds up to 18 meters/sec, along with water current in either direction of about .5 knot (51 centimeters/sec) generated by pumping 100 gallons/sec through the facility's 16 inch pipes. Electronically controlled hydraulic units at both ends of the tank can generate any wave frequency or pattern up to 10 Hz. The computer control of wind, current, and hydraulic wave generating units can accurately repeat unsteady phenomena to allow its statistical study, as well as automate the facility operation. The water within the facility

can be heated and maintained at warm temperatures, while the air flow can be cooled and humidity controlled at cool temperatures using the new coil unit in the air duct shown above.

Equipment

The main tank is our largest and most important piece of equipment. It produces and maintains the conditions under study. To measure the processes involved, we group other equipment as follows.

Air Conditions and Wind Speed

Pitot tubes for wind speed measurement, arrays of Pitot tubes for measuring wind speed simultaneously at different heights over the water, in order to compute frictional velocity, to relate to ocean conditions.

Two-channel hot film anemometer for providing wind velocity (horizontal and vertical components) and turbulence content.

Propeller type wind speed instrument for setting the wind speed.

Humidity and temperature probes to measure and set the conditions.

Active control of air temperature and humidity with the new coil unit shown above, housing both cooling and re-heating coils operated by a Johnson Control unit.

Water Conditions and Currents

Nixon propeller type current measurement for spot checks.

Two channel Laser Doppler Velocimeter for horizontal and vertical measurements of water movement under the waves, providing turbulence content.

Heaters to heat and maintain water temperature.

Hydraulic paddle units (both ends) to generate lower frequency waves under computer control.

Wave Conditions

Capacitance probes for measuring wave elevation, at chosen fetch along the tank or in clusters to measure both elevation and slope.

Mega-pixel digital video capable of 60 images/sec for recording wave slope at each pixel, wave lengths, wave speeds.

Hydrogen bubble generator to mark turbulent motions or laminar flow.

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B22-007_7725.JPG

B22-007_7726.JPG

B22-C179-179A_7728.JPG

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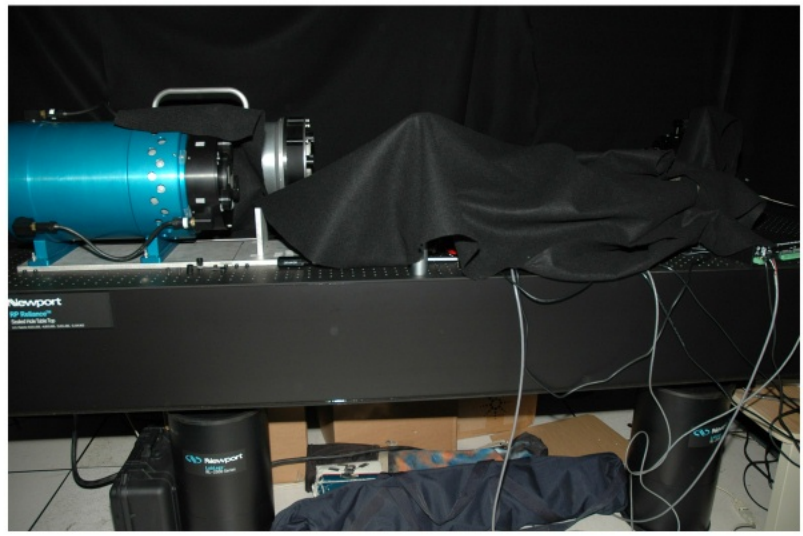

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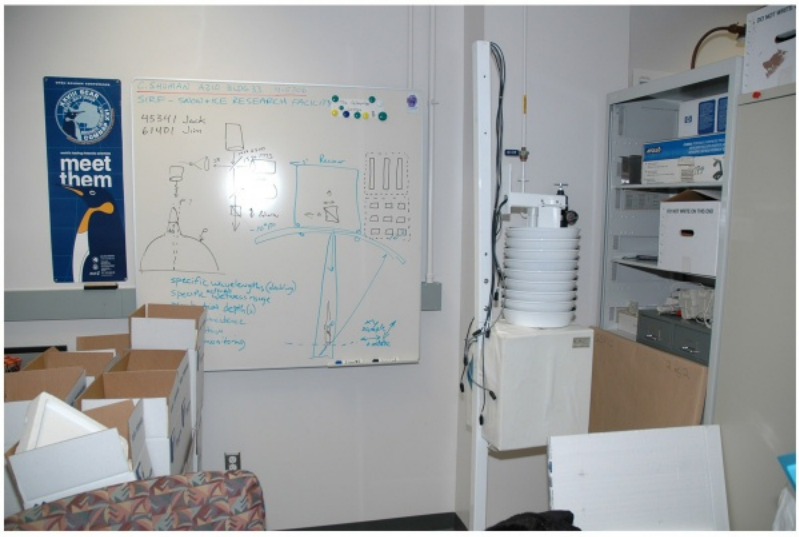

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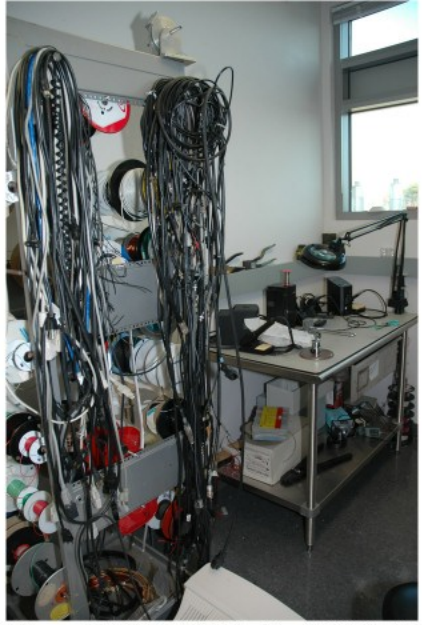

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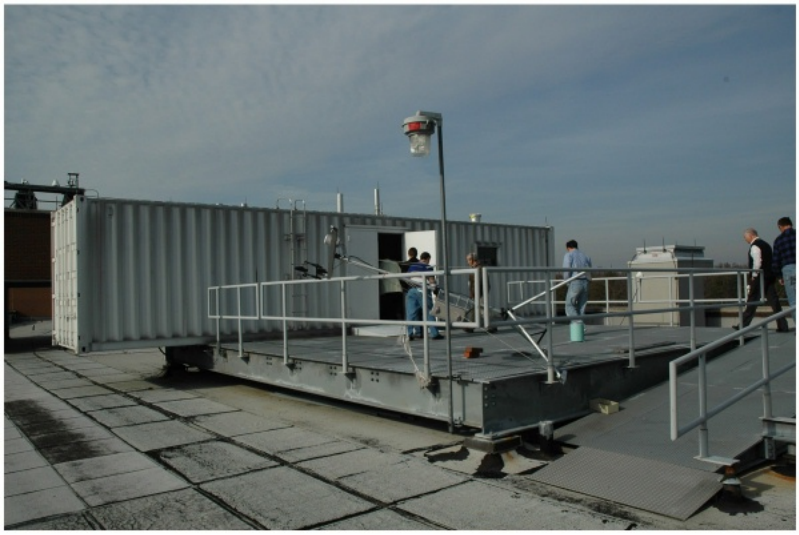

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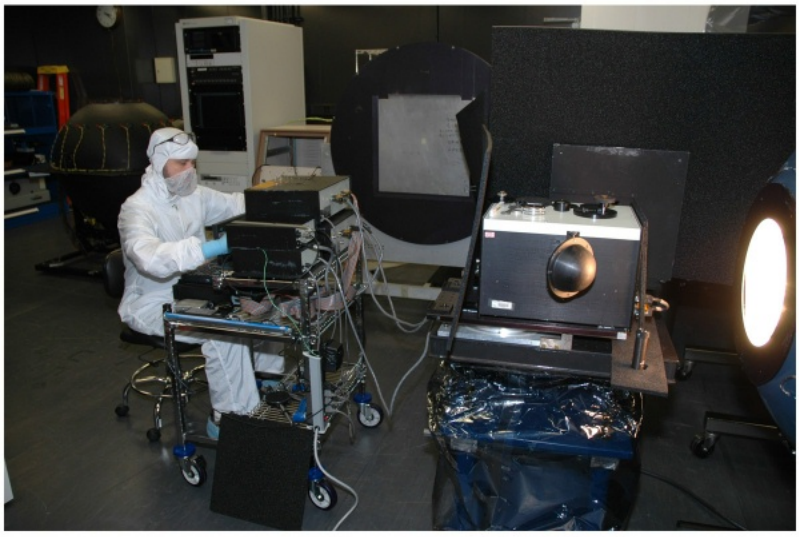

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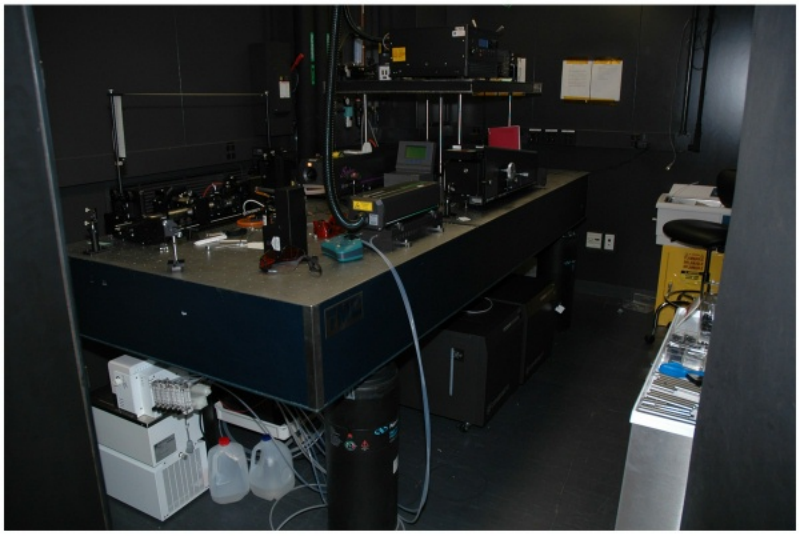

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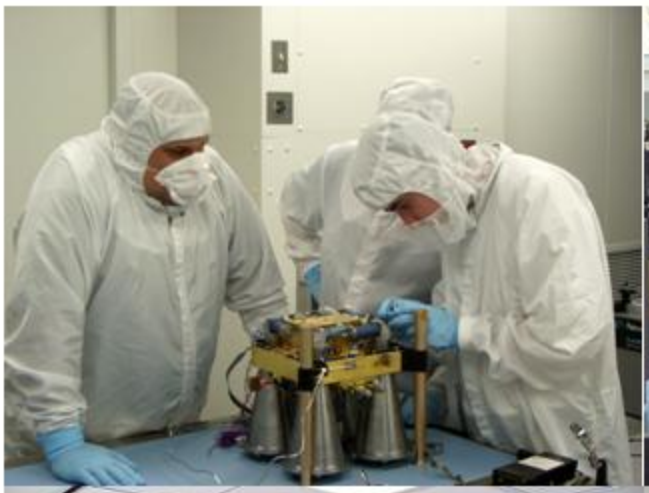
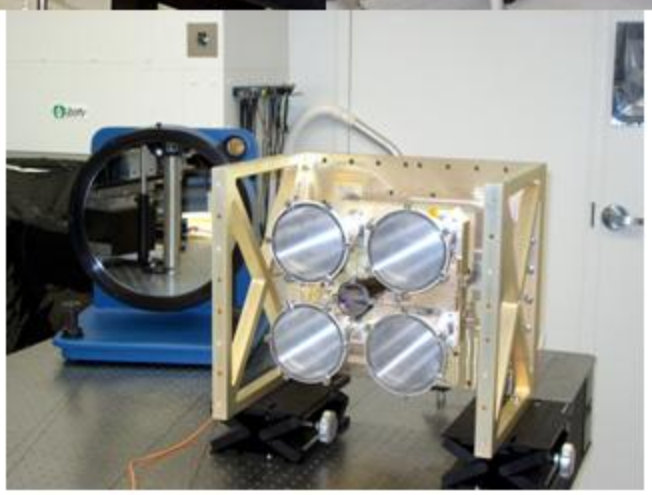
Lidar Optical Systems Lab - Clean Room Facility





Bldg. 33, Rm. F303

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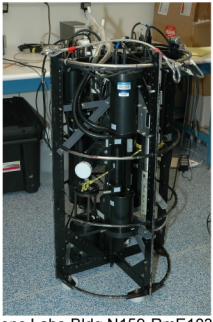

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33_Wallops Labs-Bldg N159-RmE113_8262...

34_Wallops Labs-Bldg N159-RmE113_8263...

35_Wallops Labs-Bldg N159-RmE106_8266...

36_Wallops Labs-Bldg N159-RmW143_827...

37_Wallops Labs-Bldg N159-RmW143_827...

38_Wallops Labs-Bldg N159-RmW143_827...

39_Wallops Labs-Bldg N159-RmW143_828...

40_Wallops Labs-Bldg N159-RmW143_828...

41_Wallops Labs-Bldg N159-RmW133_828...

42_Wallops Labs-Bldg N159-RmW134_829...

43_Wallops Labs-Bldg N159-RmW138_829...

44_Wallops Labs-Bldg N159-RmW138_829...

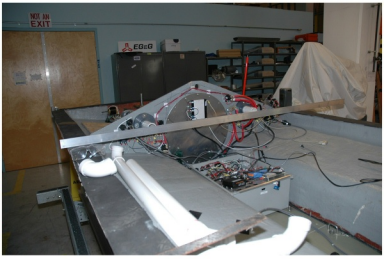
45_Wallops Labs-Bldg N159-RmW140_829...

46_Wallops Labs-Bldg N159-RmW140_829...

47_Wallops Labs-Bldg N159-RmW142_829...

48_Wallops Labs-Bldg N159-RmW142_830...

49_Wallops Labs-Bldg N159-RmW142_830...



50_Wallops Labs-Bldg N159-RmW142_830...

51_Wallops Labs-Bldg N159-RmW142_830...

52_Wallops Labs-Bldg N159-RmW148_831...

53_Wallops Labs-Bldg N159-RmW148_831...

54_Wallops Labs-Bldg N159-Dobson Spectr...

55a_Wallops Is_8367.JPG

55b_Wallops Is Labs-Bldg X15-Rm111_832...

56a_Wallops Is Labs-Bldg X15-Rm110_833...

56b_Wallops Is Labs-Bldg X15-Rm110_833...

57_Wallops Is Labs-Bldg X15-Rm110_8337....

58_Wallops Is Labs-Bldg X15-Rm110_8341....

59_Wallops Is Labs-Bldg X15-Rm109_8346....

60_Wallops Is Labs-Bldg X15-Rm109_8347....

61_Wallops Is Labs-Bldg X15-Rm108_8350....

62_Wallops Is Labs-Bldg X15-Rm112_8351....

63_Wallops Is Labs-Bldg X15-Rm107_8352....

64_Wallops Is-UAV runway_8360.JPG